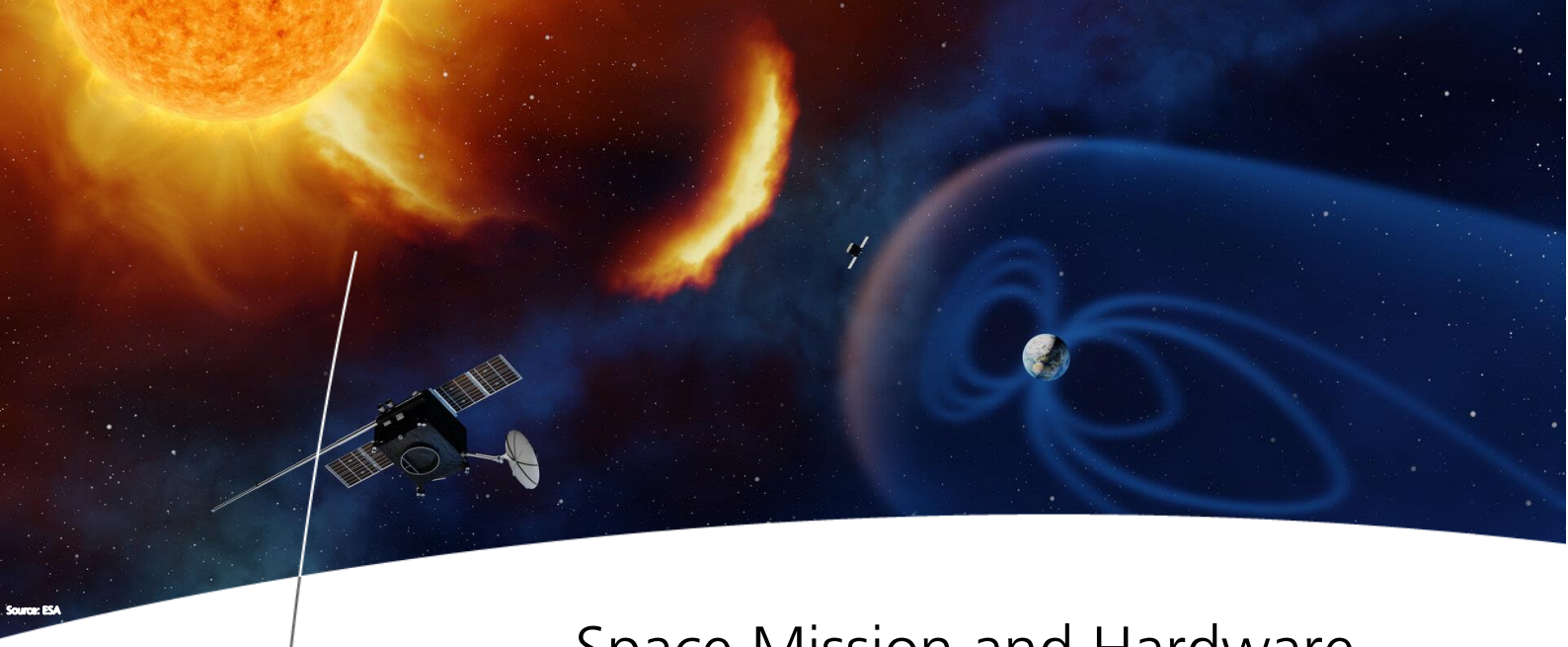


Space Mission and Hardware Design: From the Idea to a Successful Demonstration in Space

IEEE Radio & Wireless Week, Space Hardware and Radio Conference, 16th – 19th January 2022, Las Vegas, Nevada, USA

The half-day workshop aims to introduce the general workflow for space missions as seen from agencies like ESA or DLR and the requirements for a successful development and final operation in space. In this workshop, the topics space mission and hardware design are addressed: talking about critical mission phases, constraints in space hardware design and development and on how common pitfalls can be avoided. Two invited talks are presenting the lessons learned and best practice experience for scientific payloads that have been designed, developed and successful demonstrated space

Workshop Organizer

Jan Budroweit
German Aerospace Center (DLR, Germany)

Program Overview

13:30 – 13:40: **Introduction / Welcome:**

13:40 – 14:25: **Space Mission Design (Martin Drobczyk, DLR)**
Q&A (10 min)

14:25 – 15:10: **Space Hardware Design (Jan Budroweit, DLR)**
Q&A (10 min)

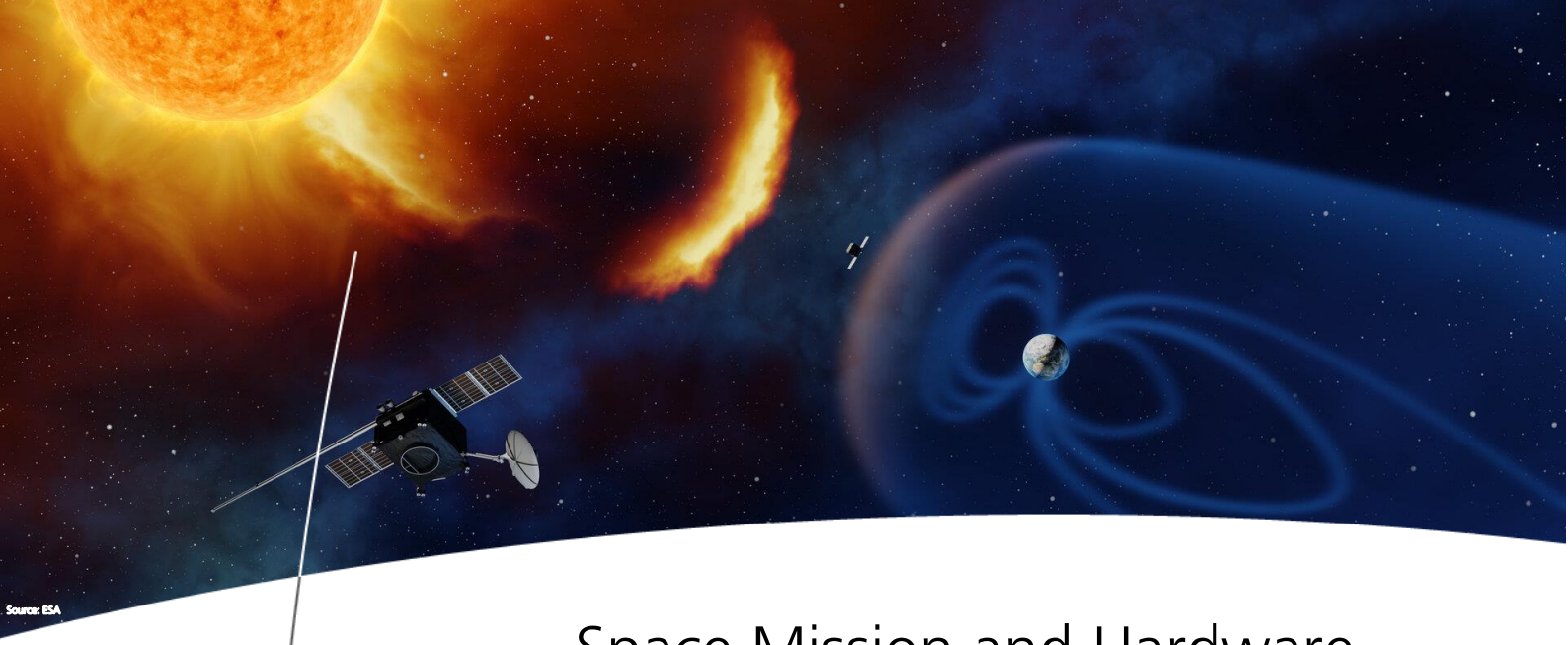
15:10 – 15:30: **Coffee Break**

15:30 – 16:15: **RF engineering for space: lessons learned from selected ESA missions (Vaclav Valenta, ESA)**
Q&A (10 min)

16:15 – 17:00: **Lessons learned on the first ADS-B Receiver in Space (Toni Delovski, DLR)**
Q&A (10 min)

17:00 – 17:30: **Wrap-Up / Panel Discussion,**

17:30: **End of Workshop**



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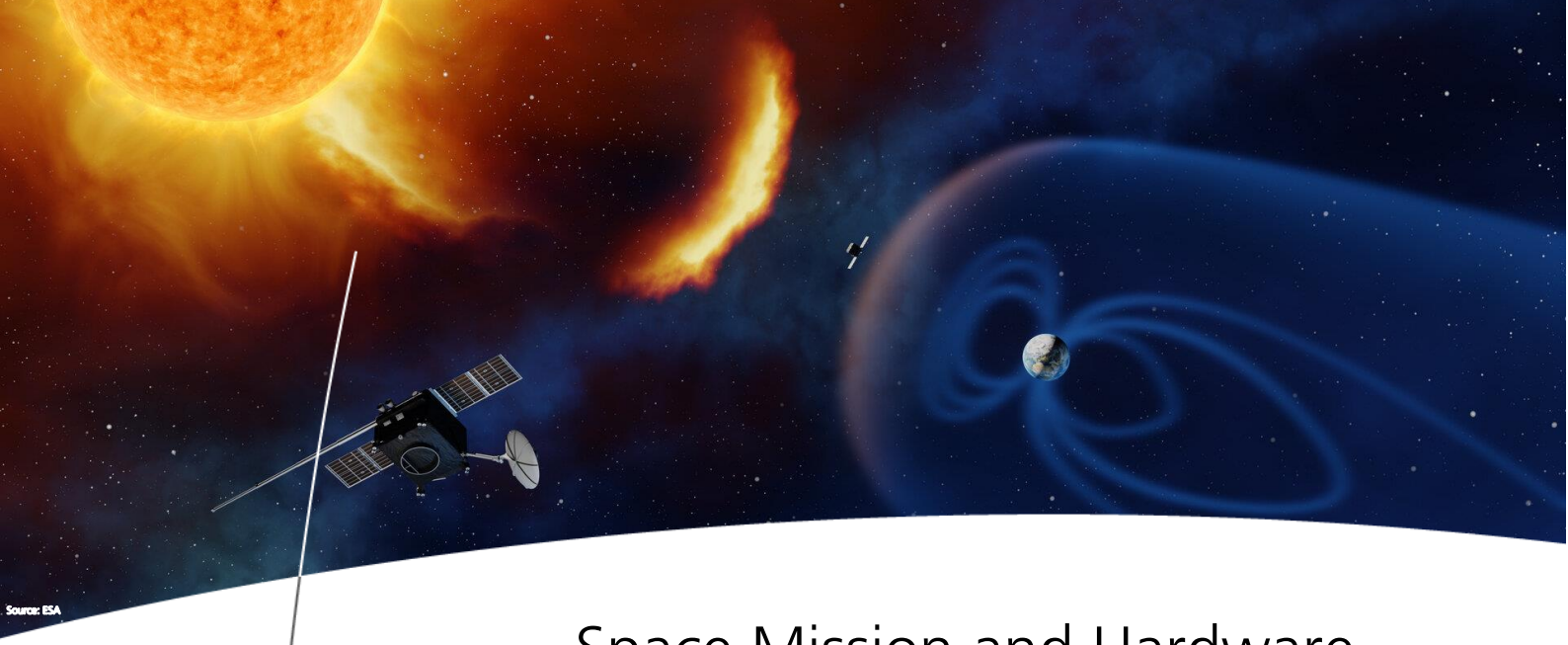
Talk #1, 13:40 – 14:25 (45min): Space Mission Design (Martin Drobczyk, DLR)
The Mission Design course introduces into spacecraft mission design, which is an essential task during the whole mission lifetime. The conceptual mission design starts right after the kick-off and includes the definition of the mission statement as well as the mission goals and mission requirements. The mission implementation can range in size from nanosatellites to deep space missions and can include several systems or a spacecraft constellation. Different project phases include the detailed spacecraft and payload design, which can be derived from the mission requirements. Moreover, the system needs to be assembled, tested and integrated as well as operated in space. For all these activities, the project management and systems engineering are the key disciplines to successfully carry out the mission.

Bio:

Martin Drobczyk received the Diploma of Eng (2008) in Aerospace Engineering from Technical University in Berlin, Germany, and the MS (2014) in Telecommunications Technology from Aston University, Birmingham, UK. In 2008, he joined the German Aerospace Center (DLR), where he has been working as a specialist of satellite communications. In 2015, he became a member of the CCSDS Onboard Wireless Working Group. His ongoing research areas mainly involve wireless intra-spacecraft communications and wireless networks, and he is currently pursuing the PhD from the University of Wuerzburg, Germany. At present, he is the head of the Power and Radio Frequency systems group in the Avionics Systems Department at DLR Institute of Space Systems in Bremen, Germany.

Q&A (10 min)



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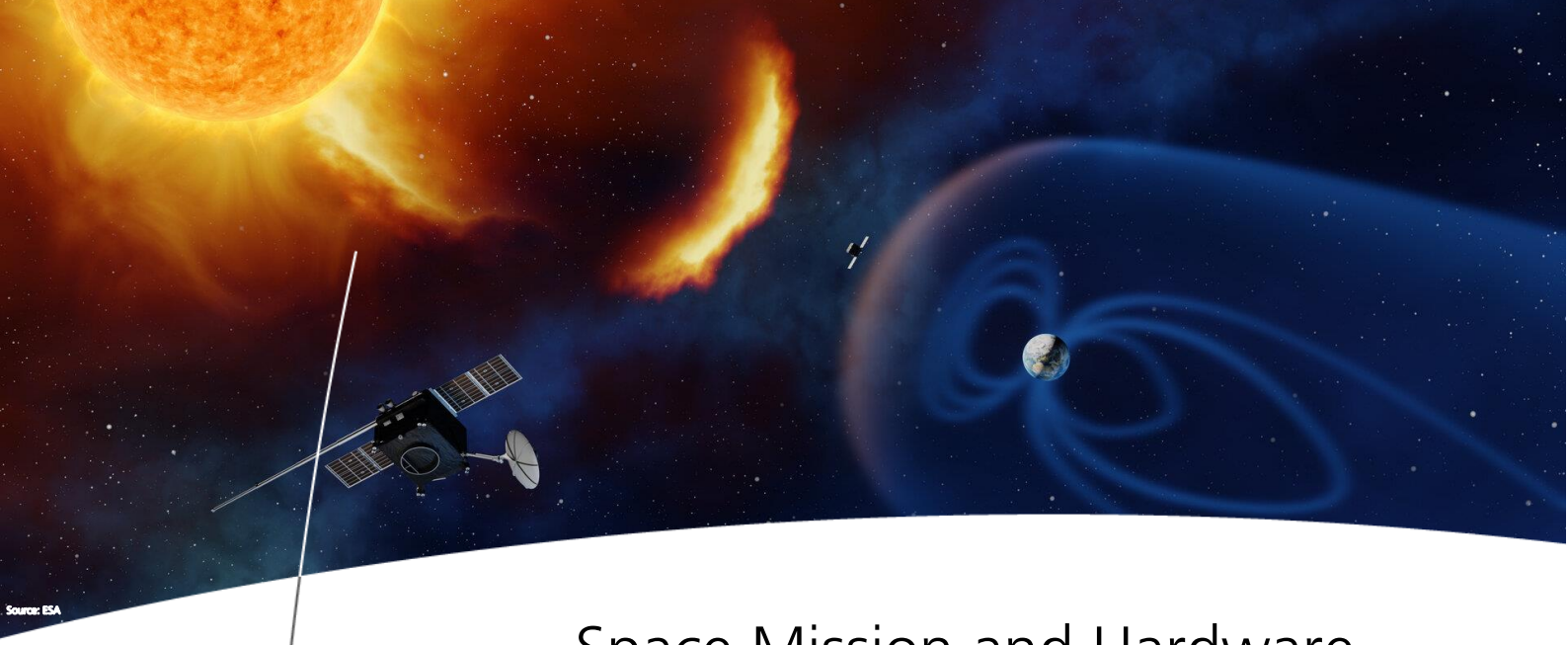
Talk #2 14:25 – 15:10 (45 min): Space Hardware Design (Jan Budroweit, DLR)
Designing hardware for space is always challenging since material and electronics will be forced by the harsh environment, i.e. thermal issue, micro-gravity and radiation. There is truly a large diversity in space hardware design as seen from the space industry and agencies or the CubeSat community, that is mainly driven by costs, time and reliability aspects. In this talk the different approaches, their advantages and disadvantages are discussed and a new approach in space hardware design will be presented including the selection of critical system elements/electronics and the qualification methodology for a radiation-tolerant communication system that has been developed by the speaker.

Bio:

Jan Budroweit received his M.Eng. (2013) in Information and Communication Systems at the Hamburg University of Applied Science (HAW), Germany. In 2021, he defended his PhD (Dr.-Ing) at the Technical University of Hamburg (TUHH) in the field of radiation-tolerant communication system design and development. In 2013, he joined the German Aerospace Center (DLR), where he has been working as an expert for satellite communications. He was the responsible communication engineer for the DLR satellite mission Eu:CROPIS which has been successfully launched in 2018. Besides his engineering activities at DLR space missions, his ongoing research areas involve the development of an integrated multiband communication platform for spacecraft. Research topics are the prediction, characterization and mitigation of radiation effects in electronic components and systems (specifically in radio systems and RF devices). Since 2020, Jan Budroweit is the founder and team leader for radiation effects in space systems supporting the ongoing space missions of the DLR.

Q&A (10 min)



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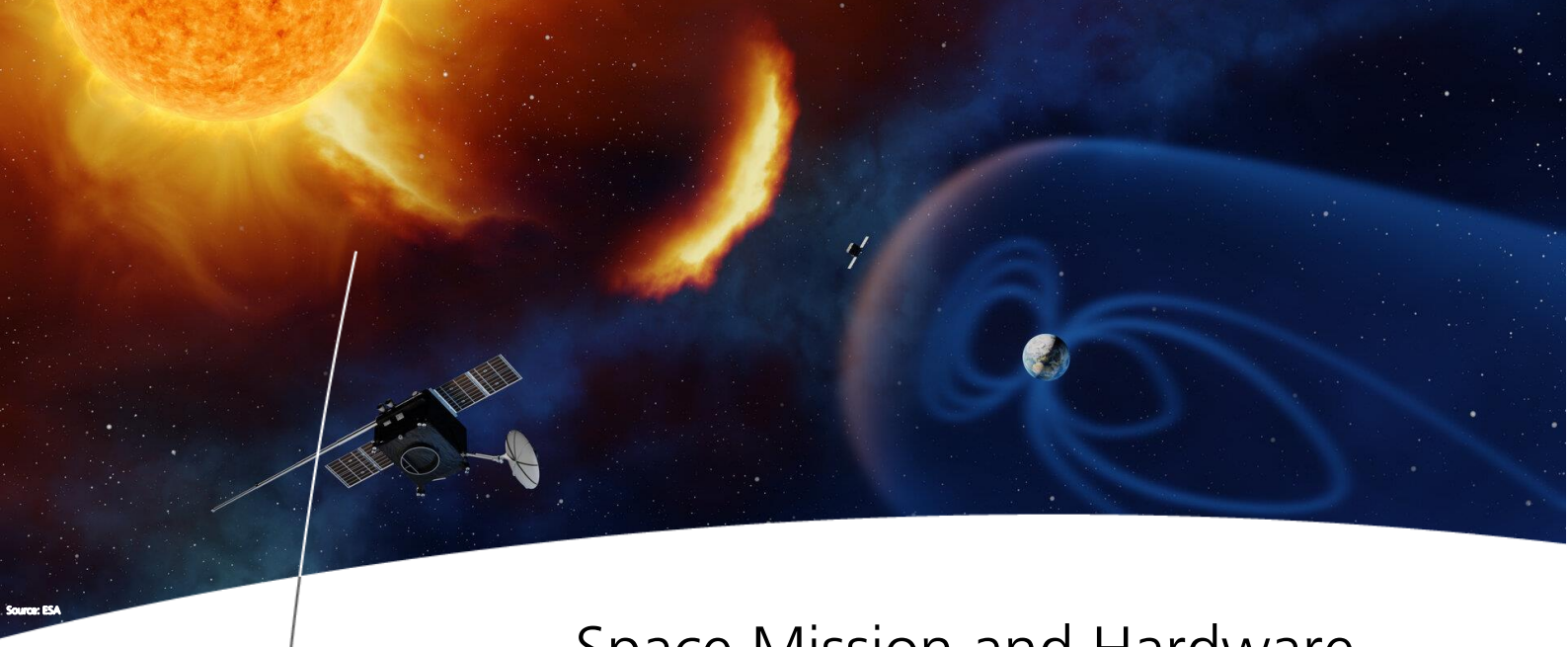
Talk #3, 15:30 – 16:15 (45 min): RF engineering for space: lessons learned from selected ESA missions (Vaclav Valenta, ESA)

RF equipment and technologies play fundamental role in all space missions. They enable reliable communication links, accurate navigation and timing and determine scientific return from deep-space missions. RF technologies are also the key enablers in the new era of Earth observation. This workshop will focus on RF engineering for space, covering the major design challenges, solutions and lessons learned from three selected mission types – earth observation, science and SATCOM.

Bio:

Václav Valenta has been with the European Space Agency since 2016. With over a decade of experience in RFIC design, he's running internal research and industrial R&D contracts in the area of RF equipment and technology, covering radar, navigation and satcom applications. His research interests include frequency generation & timing, high-power amplification and beamforming concepts in active antenna arrays and FMCW radars. Václav is the ESA lead engineer of a radio-scientific instrument LaRa embarked on the ExoMars surface platform Kozachok. He holds a dual doctoral degree in radio-engineering from the ESIEE Paris, France and the Brno University of Technology, Czech Republic.

Q&A (10 min)



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Talk #4, 16:15 – 17:00 (45 min): Lessons learned on the first ADS-B Receiver in Space (Toni Delovski, DLR)

The world's first ADS-B over Satellite (AOS) In-Orbit Demonstrator within ESAs PROBA-V mission has been launched in May 2013. The mission has successfully validated the principle of detecting weak Mode-S transponder transmissions from a Low Earth Orbit. Following this first demonstrator a couple of further missions, both from academic as well as industrial players, have been conducted. Space-Based ADS-B will improve the air traffic surveillance, specifically in non-radar airspaces, dramatically. In Jan 2022 the technology demonstrator AOS on Proba-V will be in space for 9 years and there is still no significant indication for degradation or malfunction. In a standard approach well known to the space industry almost any mission with such a long duration would be obligated to use high-rel components with military or space grade, associated with very high cost and long lead times. AOS is almost entirely made of commercial components. In this talk, we will present the experience of using those components in space over a long period and summarize some results over the mission time.

Bio:

Toni Delovski has become member of the DLR in 2009. He was part of the Satellite Systems Department of the Institute of Space Systems in Bremen, where he was involved in the payload and mission design of different low earth orbit missions. Since 2014 he is member of the Department of Systems Engineering and Project Office where he was involved in the DLR Compact Satellite Series, being responsible for the paloads of the first Compact Satellite and for the overall system design of the successor CompactSat 2. He holds a Diploma in Electrical Engineering and Information Technology from the University of Bremen.

Q&A (10 min)